of Hearing in Fich

1782

XXIII. *Account of the Organ of Hearing in Fiſh.*

By John Hunter, *Eſq. F. R. S.*

Read Nov. 14, 1782.

NATURAL hiſtory has ever been conſidered as worthy the attention of the curious philoſopher, and therefore has in all ages kept pace with the other branches of knowledge; and as both arts and ſciences have, of late years, been cultivated to a degree, perhaps, beyond what was ever known before, we find alſo, that natural hiſtory has not been neglected; all Europe appears to be awake to it. In this iſland it has been purſued with more philoſophic ardour, than what was ever known in any country. It has become the ſtudy of men of independent fortunes, who not only ſpend their fortunes in the cultivation of this ſcience, but have riſqued their health and lives in purſuit of it, ſearching unknown regions to improve mankind, ſettling correſpondences every where, ſo as to bring in its materials into this country, in order to make it the ſchool of natural hiſtory. It is no wonder, then, that a ſpirit of inquiry is diffuſed through almoſt all ranks of men; and that though many cannot purſue it themſelves, yet they are eager to know what is already known, chuſing at leaſt to benefit by the induſtry of others.

Theſe reflections have induced me to trouble this learned Society with a ſhort account of the Organ of Hearing in

Fiſh, it being ſtill a ſubject of great diſpute, whether fiſh hear or not.

Some time between the years 1750 and 1760, I obſerved the organ of hearing in fiſh; and from that time to this, I only conſidered it as a link in the chain of the varieties in this ſenſe in different animals, in which there is a regular progreſſion, *viz.* from the moſt perfect animals down to the moſt imperfect poſſeſſed of this organ *.

As I do not intend to give, in this paper, a full account of this organ in any one fiſh, or of the varieties in different fiſh, but only of the organ in general; thoſe who may chuſe to purſue this part only of the animal œconomy may think it deficient in the deſcriptive parts. If it was a difficult taſk to expoſe this organ in fiſh, I ſhould perhaps be led to be more full in my deſcription of it, but there is nothing more eaſy than the expoſure of this organ in this animal in general.

As this paper is to be confined to this order of animals, I may be allowed juſt to obſerve here, that the claſs called ſepia has this organ alſo, but ſomewhat differently conſtructed from what it is in the fiſh.

The organs of hearing in this latter order of animals are placed on the ſides of the ſkull, or that cavity which contains the brain; but the ſkull itſelf makes no part of the organ, as it does in the quadruped and the bird. In ſome fiſh this organ is wholly ſurrounded by the parts compoſing this cavity, which in many is cartilaginous, the ſkeleton of theſe fiſh being

* Preparations to illuſtrate theſe facts have been ever ſince ſhewn in my collection to the curious both of this country and foreigners: when in ſhewing whatever was new, or ſuppoſed to be new, the ears of fiſh were always conſidered by me as one important article.

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like thoſe of the ray kind; in others alſo, as in cod, ſalmon, &c. whoſe ſkeleton is bone, yet this part is cartilaginous.

In ſome fiſh this organ is in part within the cavity of the ſkull, or that cavity which alſo contains the brain, as in the ſalmon, cod, &c. the cavity of the ſkull projecting laterally, and forming a cavity there.

The organ of hearing in fiſh appears to grow in ſize with the animal, for its ſize is nearly in the ſame proportion with the ſize of the animal, which is not the caſe with the quadruped, &c. the organs being in them nearly as large in the growing fœtus as in the adult.

It is much more ſimple in fiſh than in all thoſe orders of animals who may be reckoned ſuperior, ſuch as quadrupeds, birds, and amphibious animals, but there is a regular gradation from the firſt to fiſh.

It varies in different orders of fiſh; but in all it conſiſts of three curved tubes, all of which unite with one another; this union forms in ſome only a canal, as in the cod, ſalmon, ling, &c.; and in others, a pretty large cavity as in the ray kind. In the jack there is an oblong bag, or blind proceſs, which is an addition to thoſe canals, and which communicates with them at their union. In the cod, &c. this union of the three tubes ſtands upon an oval cavity, and in the jack there are two of thoſe cavities; theſe additional cavities in theſe fiſh appear to anſwer the ſame purpoſe with the cavity in the ray or cartilaginous fiſh, which is the union of the three canals.

The whole is compoſed of a kind of cartilaginous ſubſtance, very hard or firm in ſome parts, and which in ſome fiſh is cruſted over with a thin bony lamella, ſo as not to allow them to collapſe; for as the ſkull does not form any part of

thoſe canals or cavities they muſt be compoſed of ſuch ſubſtance as is capable of keeping its form.

Each tube deſcribes more than a ſemi-circle. This reſembles in ſome reſpect what we find in moſt other animals, but differs in the parts being diſtinct from the ſkull *.

Two of the ſemi-circular canals are ſimilar to one another, may be called a pair, and are placed perpendicularly; the third is not ſo long; in ſome it is placed horizontally, uniting as it were the other two at their ends or terminations. In the ſkait it is ſomething different, being only united to one of the perpendiculars.

The two perpendiculars unite at one part in one canal, by one arm of each uniting, while the other two arms or horns have no connection with each other, and the arms of the horizontal unite with the other two arms of the perpendicular near the entrance into the common canal or cavity.

Near the union of thoſe canals into the common, they are ſwelled out into round bags, becoming there much larger.

In the ray kind they all terminate in one cavity, as has been obſerved; and in the cod they terminate in one canal, which in theſe fiſh is placed upon the additional cavity or cavities. In this cavity or cavities there is a bone or bones. In ſome there are two bones; as the jack has two cavities, we find in one of thoſe cavities two bones, and in the other only one; in the ray there is only a chalky ſubſtance †.

At this union of the two perpendiculars in ſome fiſh enters the external communication, or what may be called the external meatus. This is the caſe with all the ray kind, the external orifice

* The turtle and the crocodile have a ſtructure ſomewhat ſimilar to this; and the intention is the ſame, for their ſkulls make no part of the organ.

† This chalky ſubſtance is alſo found in the ears of amphibious animals.

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of which is ſmall, and placed on the upper flat ſurface of the head; but it is not every genus or ſpecies of fiſh that has the external opening.

The nerves of the ear paſs outwards from the brain, and appear to terminate at once on the external ſurface of the ſwelling of the ſemi-circular tubes above deſcribed. They do not appear to paſs through thoſe tubes ſo as to get on the inſide, as is ſuppoſed to be the caſe in quadrupeds; I ſhould therefore very much ſuſpect, that the lining of thoſe tubes in the quadruped is not nerve, but a kind of internal perioſteum.

As it is evident that fiſh poſſeſs the organ of hearing, it becomes unneceſſary to make or relate any experiment made with live fiſh which only tends to prove this fact; but I will mention one experiment, to ſhew that ſounds affect them much, and is one of their guards, as it is in other animals. In the year 1762, when I was in Portugal, I obſerved in a nobleman's garden, near Liſbon, a ſmall fiſh-pond, full of different kinds of fiſh. Its bottom was level with the ground, and was made by forming a bank all round. There was a ſhrubbery cloſe to it. Whilſt I was laying on the bank, obſerving the fiſh ſwimming about, I deſired a gentleman, who was with me, to take a loaded gun, and go behind the ſhrubs and fire it. The reaſon for going behind the ſhrubs was, that there might not be the leaſt reflection of light. The inſtant the report was made, the fiſh appeared to be all of one mind, for they vaniſhed inſtantaneouſly into the mud at the bottom, raiſing as it were a cloud of mud. In about five minutes after they began to appear, till the whole came forth again.

XXIV. *Account of a new Electrometer.* *By Mr.* Abraham Brook; *communicated by Sir* Joſeph Banks, *Bart. P. R. S.*

Read May 30, 1782.

AAAAN, fig. 1. repreſents the electrometer in full ſize and proportion, ſtanding on a table, or the like. The foot B is a ſquare piece of board, $9\frac{3}{4}$ inches each way, reſting on three pins C, C, *c*, ſeen at the under ſide of the foot. C, C, with the broad heads, are ſcrews to ſet the inſtrument upright withal. D is a ſolid piece of glaſs, which ſupports and inſulates the inſtrument from the place on which it ſtands. The arms G1 and *g*, with the ball F, turn round on the wire H (which is ſolid braſs, as may be alſo the arm *g*), and, when in uſe, are put near at a right angle with G2 and H, being turned to the off ſide ſo as to be as much as poſſible out of each other's atmoſpheres or the atmoſphere of a jar, battery, prime conductor, &c. The arms G1 and G2 are hollow tubes of copper, not ſo heavy as wires. The balls I1, I2, are made of copper, and hollow, ſo as to be as light as poſſible. K repreſents a kind of face or dial plate to the inſtrument with its index, which is carried once round by the motion of the arm G2 with its ball I2 moving through a quarter, or 90 degrees, of a circle; this motion is given to it by the repulſive power of the charge, &c. of electricity between the two balls I2 and L. The ends of the index from its center are of different lengths. The longeſt end reaches to a graduated circle, divided into 90 equal parts,

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